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Effect of Foliar Application and Soil Addition of Licorice and Yeast Extract: B- Vegetative Growth and Fruiting of Red Globe Grafted Grapevines

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ABSTRACT

The effect of some organic substances, Licorice extract and yeast extract either singly or in mixture as foliar spraying and soil application with different concentrations 10, 15 and 20 mg/L were investigated on Red Globe grafted grape cultivars on Freedom rootstocks. Vines used in the trial were eight years trellised by Gable system, with line spacing 1.5 x 3 m and grown in a sandy soil. Canopy division has typically been accomplished by training vines to the quadrilateral cordon system. The experiment was carried out during 2015 and 2016 seasons and it consisted of 11 treatments to improve the vegetative and reproductive growth of grafted vines. Results indicated that soil application of a combination of Licorice extract and yeast 20 mg/L was superior in stimulating all growth parameters with a significant effect on yield, cluster weight, the leaf area, leaf content of pigments, berry physical characteristics, TSS%, acidity, and anthocyanin, followed by soil application of Licorice extract and yeast 15 g/L, then the foliar spaying treatments which recorded significant increments in all characters in relation to the control.

Keywords: Grapevine, Licorice extract, yeast extract.

INTRODUCTION

Natural and safety substances have been used in a great scale as fertilizers to improve plant growth, yield and quality of many crops. These organic fertilizers improve the soil texture as well as soil fertility due to increasing humus contents in the soil. They have been also extensively used as an environmental friendly approach to decrease the use of inorganic fertilizers, enhance soil fertility status and crop production (Ram Rao *et al.* 2007).

The organic substances used in this experiment were chosen for their beneficial effects as they contain minerals and some plant growth regulator which affect the plants positively as follow:

Licorice *(Glycyrrhiza glabra)* extract is made from plants belonging to the family Leguminoseae. It contains more than 100 compounds including triterpene saponins and phenolic compounds (Shibata 2000; Shabani *et al.* 2009). It also used as biofertilizers rich in amino acids, vitamins and stimulating photohormones (Rawlings *et al.* 1994 and Lin *et al.* 2003). Beside, it contains many minerals such as potassium, phosphorus, magnesium and iron, (Laroche et al. 2001).

Yeast extract *(Saccharomyces cervicisae, L.)* is one of the biofertilizers used for many crops (Gomaa and Mohamed 2007). It activates some for many physiological processes in plants such as photosynthesis through enhancing Co2 release (Larson et al. 1962). Beside, it contains some natural growth regulators such as auxins (Moor 1979), as well as increase uptake of various nutrients, i.e. N, P and K and some common amino acids (Abou-Zaid 1984).

This investigation is aiming to find alternative organic fertilizers to replace partially the chemical fertilizers which affect human health negatively and identify the optimal combinations from active yeast extract and Licorice extract without adversely affecting yield components or fruit composition of 'Red Globe' for sustainable grape production.

MATERIALS AND METHODS

This investigation was performed during two successive seasons 2015 and 2016 in a vineyard located at Belbes, Sharkia governorate. Eight years-old Red Globe grapevines planted in a sandy soil and trellised by Gable system, with line spacing 1.5 x 3 m were used in this investigation. The vines were pruned during the first week of January. Canopy division has typically been accomplished by training vines to the quadrilateral cordon system. Four permanent arms are established from a single vine (2 on each side of the canopy) leaving 48 fruiting spurs x 2 buds each with a total vine load of 96 buds. Vines were adjusted to 40 clusters per vine. They were irrigated through drip irrigation system. For this study, Ninety nine uniform vines were chosen (11 treatments x 3 replicates x 3 vines / replicate). The vines were uniform in vigor and received common horticultural practices.

Eleven organic treatments were applied as eight foliar application and two soil addition, 3 times and sprayed each 15 days (at shoots having 15-20 cm length, pre-bloom and at the berry set) as follow:

1- Foliar application of Licorice extract 10 g/L (L.)
2- Foliar application of Licorice extract 15 g/L
3- Foliar application of Licorice extract 20 g/L
4- Foliar application of Yeast extract 10 g/L (Y.)
5- Foliar application of Yeast extract 15 g/L
6- Foliar application of Yeast extract 20 g/L
7- Foliar application of Licorice 15 g/L+Yeast extract 15 g/L (L.+Y.)
8- Foliar application of Licorice 20 g/L+Yeast extract 20 g/L
9- Soil addition of Licorice 15 g/L+ Yeast extract 15 g/L
10- Soil addition of Licorice 20 g/L+ Yeast extract 20 g/L
11- Control (C).

1- Leaves measurements:

a- Leaf surface area (cm^2): Samples of leaves were randomly collected from each treatment for leaf surface area determination, (using leaf area meter, Model CI 203, U.S.A.) at harvest.
b- Chlorophyll A, B & Carotene: ten leaves per replicate were collected for the determination of total chlorophyll content (mg/100 g fresh weight).

2- Physical characteristics of berries and yield:

a- Yield (kg / vine).
b- Average cluster weight (g).
c- Average berry weight (g), size (cm^3) and dimensions (cm).
d- Berry adherence strength (g/cm^2) measured using Chatilons instrument.

3- Chemical characteristics of berries:

Representative random samples of 15 clusters / treatment (5 cluster from each replicate) were collected when clusters reached their full color and total soluble

solids reached about 18 – 20 %, according to Badr and Ramming (1994).

The following determinations were carried out:

a- Refractometric total soluble solids (TSS %) and titratable acidity as gram of tartaric acid per 100 ml of juice (A.O.A.C., 1985) and TSS / acid ratio were calculated.

b- Total anthocyanin in berry skin using spectrocolourimeter at 250 µm according to Yilidz and Dikmen (1990).

4- Experimental design and statistical analysis:

Randamized complete block design was adopted. New L.S.D. method at 5% level was used to compare treatment means by the method of Snedecor and Cochran (1980).

RESULTS AND DISCUSSION

1- Physical and chemical characteristics of leaves:

a. Leaf area:

The development of the leaf area is considered one of the important characteristic that affect yield and fruit quality of grapevines. Effect on average leaf area of Red Globe was shown in table (1). The recorded data reveals that all treatments were significantly different and the highest data were recorded by the treatment of a mixer of Licorice extract and yeast 20 g/L as soil application, followed by Licorice extract and yeast 15mg/L. The least values were obtained from the mixed foliar spraying treatments 20 and 15 g/L and single spraying of yeast 20g/L then the control respectively in the two seasons of study. These results were in harmony with those recorded by Larson *et al.* (1962) who noticed the positive effect of yeast on leaf area is to its photosynthesis activation due to enhance the release of carbon dioxide. Also, yeast naturally promotes the growth promoters as it contains IAA and cytokinins which help in increasing the leaf area (Moor 1979). Moreover, Gaser *et al.* (2006) pointed out that yeast application as soil addition or foliar spray significantly increased the vegetative growth compared with the control in Flame seedless grapevines. Shafeek *et al.* (2015) found an increment in the average leaf area by foliar spraying with Licorice extract of onion plant.

Table 1. Impact of spraying licorice extract and yeast on leaf area, total chlorophyll a,b and total carotenoids of Red Globe grapes during the two growing seasons 2015 and 2016

Treatments	Leaf area (cm^2)		Total chlorophyll a,b (mg/ 100 g fw)		Total carotenoids (mg/ 100 g fw)	
	1 st Season	2 nd Season	1 st Season	2 nd Season	1 st Season	2 nd Season
Foliar spraying of Licorice 10 g/L	130.4	132.3	35.3	34.9	0.51	0.52
Foliar spraying of Licorice 15 g/L	148.3	150.8	39.5	39.7	0.61	0.62
Foliar spraying of Licorice 20 g/L	157.5	159.4	41.0	41.9	0.66	0.68
Foliar spraying of Yeast 10 g/L	123.1	129.6	33.6	34.3	0.46	0.47
Foliar spraying of Yeast 15 g/L	139.3	140.1	37.2	37.8	0.57	0.57
Foliar spraying of Yeast 20 g/L	95.0	100.2	29.1	29.6	0.36	0.39
Foliar spraying of Licorice +Yeast (15 g/L)	112.2	115.1	31.5	31.9	0.41	0.42
Foliar spraying of Licorice + Yeast (20 g/L)	102.1	106.5	30.2	31.1	0.39	0.41
Soil addition of Licorice + Yeast (15 g/L)	168.4	169.5	43.2	44.5	0.70	0.73
Soil addition of Licorice + Yeast (20 g/L)	177.3	180.0	45.5	46.3	0.77	0.80
Control	80.8	81.7	27.5	28.1	0.31	0.30
New L.S.D at 5%	**2.3**	**3.2**	**0.9**	**0.7**	**0.06**	**0.04**

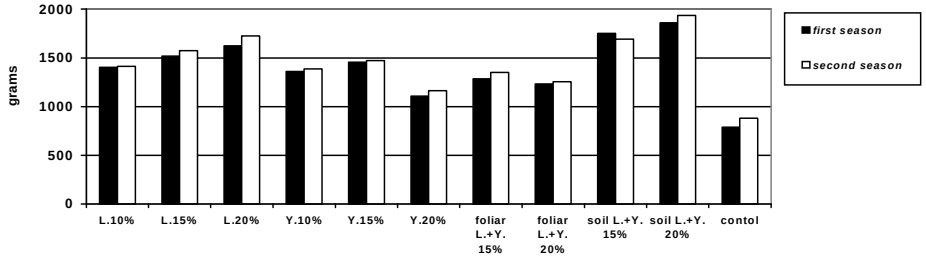
b. Chlorophyll A, B & Carotene:

By looking at the impact of both foliar and soil application of yeast and Licorice extract in different concentration on pigments leaf content, results in Table (1) obviously indicated that soil addition of Licorice extract and yeast extract 20 g/ L as well 15 mg/L significantly increased leaves chlorophyll a & b and total carotenoids in relative to the foliar applications and the control treatment. The superiority was found in using a concentration of 20 g/ L than using 15 g/ L in enhancing the vine nutritional status. Foliar application treatments by Licorice extract 20 g/ L occupied the third rank in this respect and yeast 20 g/L application ranked the last position then the control. The superiority on these parameters was significantly associated with increasing concentration from 10 to 20 g/ L. A slight and insignificant effect on these respects was detected among the foliar concentrations. Yeast positive effect may be returned to its benefits in activating photosynthesis process by increasing the release of carbon dioxide (Larson *et al.* 1962). Furthermore, Zuhair (2010) who studied the effect of different concentrations of licorice found that it gave a significant increase in total chlorophyll content.

2- Physical characteristics of berries and yield:

a. Yield per vine (kg):

All clusters on the vine in each treatment were counted at harvest time and the total cluster fresh weight was recorded for each. It is obvious from the figure (1) that the combined soil addition treatments of Licorice and yeast extract 20 g/ L followed by a concentration of 15 g/ L were significantly effective on improving grapevines yield in both seasons comparing with the use of foliar applications alone and the control. These results agreed with those obtained from Gaser *et al.* (2006) on Flame seedless who found that yeast applications significantly increased the yield/vine. In addition, Qaraghouli and Jalal (2005) mentioned that licorice extract sprayed on apple trees gave the highest value in yield and fruit quality.

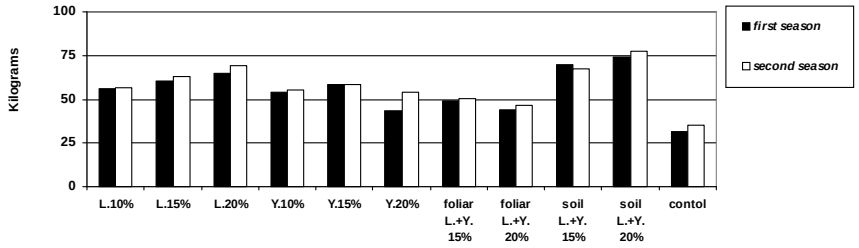


L. = Licorice **Y. = Yeast**

Fig. 1. Yield per vine in kilograms as affected by different treatments for Red globe grapevines during the two growing seasons 2015 and 2016

b. Cluster weight (g):

An obvious increase in cluster weight grew with the fertilizer concentration was shown in figure (2). The soil addition treatments were significantly the most effective in increasing the cluster weight in both seasons. Zainhoum (2015) reported that the best results concerning the bunch weight were obtained by spraying licorice root extract. On the contrast, control treatment recorded the lowest values in both seasons of study.



L. = Licorice **Y. = Yeast**

Fig. 2. Cluster weight in grams as affected by different treatments for Red globe grapevines during the two growing seasons 2015 and 2016

c. Average berry weight, size and dimensions:

Berry weight and size are considered as important quality parameters for table grapes. From results of statistical analysis displayed in table (2), it is obvious that the mean values of berry weight in both foliar application and soil addition of Licorice extract and yeast extract recorded significant differences in berry weights. The most effective treatment emerged by adding a soil of a combined of Licorice extract and yeast 20 g/L and 15g/L concentrations respectively. These findings are in agreement with those previously recorded by Rawlings *et al*. (1994) who explained that the effects could be through to availability of Licorice extract in enhancing the activity of apical meristem tissue which in turn led to cell division and elongation as it is rich in amino acids, vitamins and growth stimulating photo-hormones.

Table 2. Impact of spraying licorice extract and yeast on berries physical characteristics of Red Globe grapes during the two growing seasons 2015 and 2016

Treatments	Berry weight (g)		Berry size (cm^3)		Berry length (cm)		Berry width (cm)		Berry adherence (g/cm^2)	
	1 st Season	2 nd Season	1 st Season	2 nd Season	1 st Season	2 nd Season	1 st Season	2 nd Season	1 st Season	2 nd Season
Foliar spraying of Licorice 10 g/L	14.1	14.7	12.4	12.6	2.1	2.2	2.2	2.3	752	765
Foliar spraying of Licorice 15 g/L	15.2	15.6	13.0	13.3	2.5	2.4	2.4	2.6	819	825
Foliar spraying of Licorice 20 g/L	15.7	15.9	13.5	13.6	2.8	2.9	2.5	2.7	853	859
Foliar spraying of Yeast 10 g/L	13.7	14.1	12.1	12.5	2.0	2.1	2.0	2.2	740	741
Foliar spraying of Yeast 15 g/L	14.6	14.9	12.7	13.1	2.3	2.3	2.3	2.4	788	790
Foliar spraying of Yeast 20 g/L	12.3	12.5	10.8	10.9	1.7	1.8	1.7	1.9	715	721
Foliar spraying of Licorice+Yeast (15g/L)	13.4	13.0	11.7	11.9	1.8	2.0	1.9	2.1	728	732
Foliar spraying of Licorice+Yeast (20g/L)	12.6	12.8	11.3	11.2	1.6	1.8	1.5	1.6	679	686
Soil addition of Licorice+Yeast (15 g/L)	16.0	16.4	13.8	14.0	3.0	3.1	2.8	3.0	868	865
Soil addition of Licorice+Yeast (20 g/L)	16.5	16.8	14.1	14.7	3.2	3.3	3.0	3.2	892	897
Control	11.8	12.1	10.1	10.3	1.5	1.4	1.4	1.3	653	650
New L.S.D at 5%	**0.1**	**0.2**	**0.1**	**0.1**	**0.09**	**0.07**	**0.08**	**0.06**	**7.15**	**8.01**

d. Berry adherence:

Data in Table (2) showed that using Licorice extract plus yeast extract 20g/L as soil application significantly enhanced the berry adherence, compared to other treatments and the control in 2015 and 2016 seasons. In an agreement with the present results those obtained by Osthuyes (1993) who found that yeast extracts increased the fruit retention and decreased fruit drop when sprayed on mango trees. Also, Zainhoum (2015) stated that the highest significant value of fruits firmness obtained from spraying licorice extract as compared with the control treatment.

3- Chemical characteristics of berries:

a. Total soluble solids (TSS %), Titratable acidity % and TSS / acid ratio:

Significant differences among treatments in TSS %, titratable acidity and TSS / acid ratio were recorded in table (3). A combined of Licorice extract and yeast extract 20 g/ L soil application significantly enhanced berries quality in terms of enhancement TSS %, and reducing total acidity % compared to other treatments and the control in 2015 and 2016 seasons. The positive impact could be due to yeast application as it enhances the effects of photosynthesis processes and increases the promoter hormones as cytokinins (Moor 1979). It is well known that these hormones induce a considerable amount of sugar contents and consequently caused an increase in TSS %, TSS/acid ratio and a decrease in acidity % in the grape juice.

Table 3. Impact of spraying licorice extract and yeast on berries chemical characteristics of Red Globe grapes during the two growing seasons 2015 and 2016

Treatments	T.S.S %		Acidity %		T.S.S/ acid Ratio		Anthocyanin (mg/100g fw)	
	1 st Season	2 nd Season	1 st Season	2 nd Season	1 st Season	2 nd Season	1 st Season	2 nd Season
Foliar spraying of Licorice 10 g/L	15.7	15.9	1.2	1.1	13.0	14.4	31.0	31.2
Foliar spraying of Licorice 15 g/L	16.8	17.0	0.9	0.9	18.6	18.8	34.3	35.1
Foliar spraying of Licorice 20 g/L	17.2	17.5	0.7	0.8	24.5	21.8	36.6	37.3
Foliar spraying of Yeast 10 g/L	15.4	15.8	1.3	1.3	11.8	12.1	30.7	30.9
Foliar spraying of Yeast 15 g/L	16.0	16.3	1.0	1.0	16.0	16.3	32.5	33.4
Foliar spraying of Yeast 20 g/L	14.2	14.4	1.6	1.7	8.8	8.4	29.0	29.4
Foliar spraying of Licorice +Yeast (15 g/L)	15.1	15.3	1.5	1.5	10.0	10.2	30.1	30.4
Foliar spraying of Licorice + Yeast (20 g/L)	14.7	15.0	1.7	1.8	8.6	8.3	28.5	28.7
Soil addition of Licorice + Yeast (15 g/L)	19.6	19.8	0.5	0.5	39.2	39.6	39.7	40.6
Soil addition of Licorice + Yeast (20 g/L)	20.3	20.6	0.4	0.3	50.7	68.6	43.2	44.1
Control	13.5	13.7	1.9	2.0	7.1	6.85	28.5	28.6
New L.S.D at 5%	**0.2**	**0.1**	**0.04**	**0.03**	**0.7**	**0.6**	**0.03**	**0.04**

b. Total anthocyanin:

Data in table (3) clearly showed that the maximum anthocyanin content in the berry skin was gained by the soil addition treatments, which significantly affected the accumulation of anthocyanin in Flame Seedless in both seasons compared to controls. Increases in anthocyanin content of berries was reported also by Hegab *et al.* (2010) who found that the highest value of anthocyanin was obtained from the application of 9 g yeast 4 weeks after fruit set. Moreover, spraying with licorice extract gave the highest value of anthocyanin as mentioned by Zainhoum (2015).

CONCLUSION

In conclusion, both soil addition and foliar application of plant extracts of Licorice in mixer of organic extracts such as yeast significantly improved the vegetative growth and yield of Red Globe grapevines than the control with superiority for the soil addition treatments. Soil application treatment with a mixer of licorice and yeast extracts at (20 g/L) were the best compared to other treatments in terms of all investegated parameters. These natural compounds can be used safely as partially alternatives to replace the chemical fertilizers and growth regulators to improve the grapevines quality and productivity.

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تأثير الرش الورقى والإضافة الأرضية لمستخلص العرقسوس والخميرةعلى:
ب- النمو الخضرى والإثمار لكرمات العنب الرد جلوب المطعومة

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قسم بحوث العنب – معهد بحوث البساتين – مركز البحوث الزراعية – الجيزة

تم دراسة تأثير إضافة مستخلص العرقسوس والخميرة منفرداً أو مخلوط رشا على الاوراق أو إضافة أرضية بتركيز ١٠ ، ١٥ ، ٢٠ جم / لتر وذلك لصنف الرد جلوب المطعوم على أصل الفريديم. أجريت التجربة خلال موسمى ٢٠١٥ – ٢٠١٦ بأحد المزارع بمنطقة بلبيس محافظة الشرقية وكانت عمر الكرمات ٨ سنوات نامية فى تربة رملية على مسافة ٣x١.٥ متر، وتروى بنظام الرى بالتنقيط، الكرمات مربة بنظام الكردو ن المزدوج. تم تقليم الكرمات تقليما دابري تحت نظام التدعيم "جيبل" تم تقليم الكرمات في الأسبوع الأول من يناير مع ترك حمولة براعم (٩٦ عين / كرمة). تشمل الدراسة إحدى عشر معاملة منها تسع معاملات رش ورقى ومعاملتين إضافة أرضية وأظهرت النتائج أ ن الأضافة الأرضية لمخلوط العرقسوس والخميرة بتركيز ٢٠ جم / لتر أعطت أفضل معاملة وأدت الى زيادة كمية المحصول ، ووز ن العنقود ، مساحة سطح الورقة ، والكلورفيل ، وصفات الحبات ، والمواد الصلبة الذائبة الكلية ، والحموضة ، وصبغة الأنثوسيانين يليها الإضافة الأرضية لمخلوط العرقسوس والخميرة بتركيز ١٥ جم / لتر ثم الرش الورقى مقارنة بالكنترول.